ET2A Electronic Digital Theodolite

MAINTENANCE GUIDE

V1.0

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CE This product has been tested and found to comply with European Council Directive 2014/30/EU, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA). These requirements are designed to provide reasonable protection against harmful interference when the device is operated in a residential or commercial environment.

Contents

1 Before You Start

Before you start, please carefully read this part.

1.1 Precautions for Safe Operation

Precautions in this part are intended to minimize the risk of personal injury and/or damage to property, and all indicate **ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!**

Precautions can be divided into the following types according to the degree of loss or injury in case of negligence or omission:

 NOTE	*Indicates important paragraphs that must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.*
 CAUTION	*Indicates a potentially hazardous situation that, if not avoided, may result in INJURY OR PROPORTY DAMAGE OR IRRETRIEVABLE DATA LOSS.*
 WARNING	*Indicates a potentially hazardous situation that, if not avoided, could result in SERIOUS INJURY OR EVEN DEATH.*
 DANGER	*Indicates an imminently hazardous situation that, if not avoided, will result in VERY SERIOUS INJURY OR EVEN DEATH.*

1.1.1 Caution

The following outlines the cautions that you must avoid when operating the **ET2A**:

	For optimum usage, please regularly check and adjust the instrument (at least every three-month) especially after storage for a long time and transportation.
	Please make sure there is no leaves or obstacles between the target and the instrument for good measuring result.
	Please set up the instrument on the tripod, and make sure the connection between the tripod and instrument is firm.
	When transporting, please keep the instrument in the case provided and try your best to minimize vibration of the instrument.
	Please do not store the instrument in high temperatures or set it up under strong sunlight to present the photosensor from heating up as it may affect the accuracy of the instrument.
	Please avoid direct sunlight from passing through the objective and eyepiece which may cause interference.
	Please do not touch the lens with your fingers. And please clean the surface, buttons, screen and outer layer of the instrument with a soft cloth, and clean the optical parts only with lens paper.
	Please store the instrument and battery in a dry and cool place with proper temperature.
	When carrying the instrument, please tightly hold the handle.
	Please do not take out the battery when the instrument is on, and please replace the battery after powering off the instrument. Otherwise, the stored data may be lost.
	Please do not touch the instrument with wet hand. Otherwise, electric shock may occur.
	Please do not arbitrarily stand or seat on the carrying case, or turn over it. Otherwise, the instrument may be damaged.
	Please be careful of the tripod tiptoe when setting up or moving it.
	Once your work is completed, please clean the instrument, and keep it back into the case.
	Please do not drop the instrument or the carrying case, or use defective belt, agraffe or hinge. Otherwise, the instrument may be damaged.
	Please do not touch liquid leaking from the instrument or battery. Otherwise, harmful chemicals could cause burn or blisters.

1.1.2 Warning

The following outlines the warnings that you must avoid when operating the **ET2A**:

	This instrument is only for qualified surveyor or professional users who have a good knowledge of surveying.
	To avoid permanent eye damage, please do not point the laser beam at other's eyes, do not directly look into the laser beam source, do not stare at the laser beam, and do not look at the laser beam through a telescope or other optical devices.
	Please do not collimate the sun directly. Otherwise, eye injury or blindness and objective damage may occur.
	Please do not cover the charger when charging. Otherwise, fire may occur.
	Please do not use wet battery or charger, defective power cable, socket or plug, and power cable and battery not specified by eSurvey. Otherwise, fire or electric shock may occur.
	Please do not put the instrument close to burning gas or liquid and the battery in the fire or high temperature condition, and do not use the instrument in coal mine. Otherwise explosion may occur.
	Please avoid short circuit of the battery. Otherwise, fire may occur.
	Please avoid disturbance of severe electrostatic discharge. Otherwise, degraded performances of the instrument may occur, like switching on/off automatically, etc.

1.1.3 Danger

The following outlines the danger that you must avoid when operating the **ET2A**:

	Only eSurvey authorized distributors can disassemble or rebuild the instrument.
	If you need to replace important parts, please do not replace the parts of other brands without permission.

1.2 Disclaimer

You are expected to follow all operating instructions and regularly check the performance of this instrument. It is your responsibility to exercise common sense while using the **ET2A**, and keep it operating safely.

We assume no responsibility for any damage and loss of profits in the following conditions:

- A faulty or intentional usage or misuse.
- Any disasters, such as earthquakes, storms, floods etc.
- A change of data, loss of data, an interruption of business etc.
- Wrong transport.
- Use of non-original parts.
- Usage not explained in the user guide.

2 ET2A at a Glance

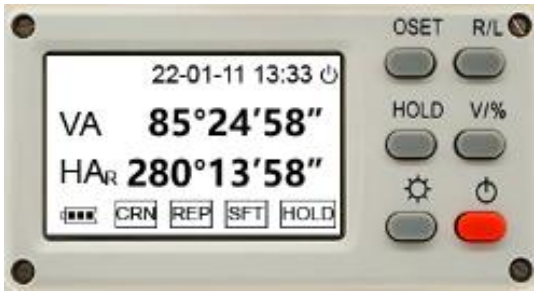
2.1 Important Parts

The important parts of **ET2A** is as follows:

1. Handle
2. Telescope
3. Objective
4. Battery
5. Diopter ring
6. Eyepiece cover
7. Focusing knob
8. Optical sight
9. Telescope cover
10. Eyepiece
11. Tribrach
12. Foot screw
13. Plate level
14. Vertical tangent screw
15. Horizontal tangent screw
16. Circular level
17. Display

2.2 Operation Panel

The operation panel is as follows:



Keyboard

Keys	Meaning
0SET	Set the horizontal angle to 0.
R/L	Set the horizontal angle right or left.
HOLD	Hold the horizontal angle.
V/%	Set the display unit of the vertical angle (° or %) by pressing 1 second and turn on or off the laser pointer by pressing 3 seconds.
☼	Turn on or off the light by pressing 3 seconds.
⏻	Power on or off the instrument by pressing 3 seconds and turn on or off the laser plummet by pressing 1 second after powering on the instrument.
☼ + R/L	Configure the instrument.
☼ + HOLD	Measure the same horizontal angle several times.

Display

Characters	Meaning
22-01-11	The current date (year-month-day).
13:33	The current time.
⏻	The instrument will automatically power off within 30 minutes if no action is carried out.
VA	The vertical angle.
HA^L	The horizontal angle left.
HA_R	The horizontal angle right.
▮▮▮	The battery level.
CRN	The compensator is ON.
REP	Measure the same horizontal angle several times.
HOLD	Hold the horizontal angle.
SFT	Change the function.

3 Disassembling

DANGER	When disassembling the instrument, please carefully protect each part. It is forbidden to disassembling parts not mentioned here.

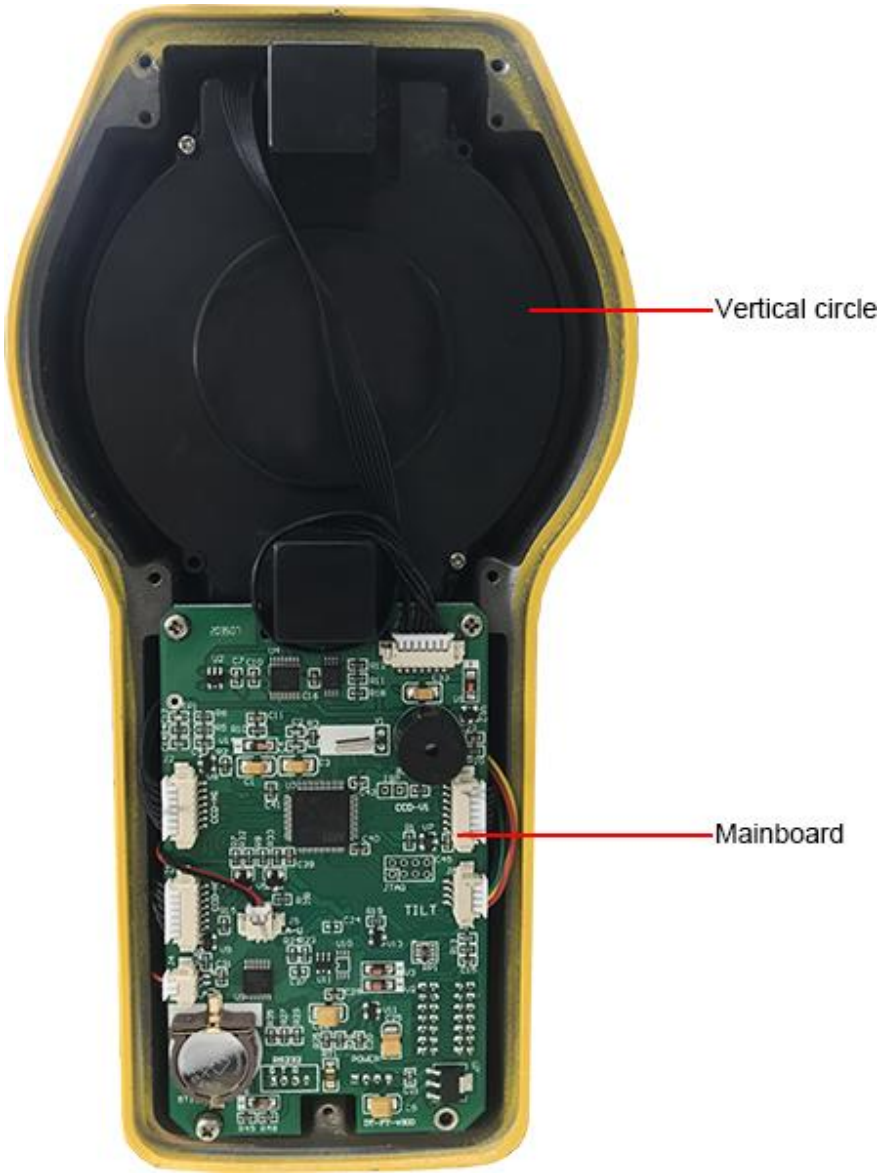
3.1 Disassemble the Left Cover

To disassemble the left cover, do the following:

1. Remove four cross recessed pan head screws (M2.5X10) screws and one cross recessed pan head screw (M2.5X20) that fix the left cover:

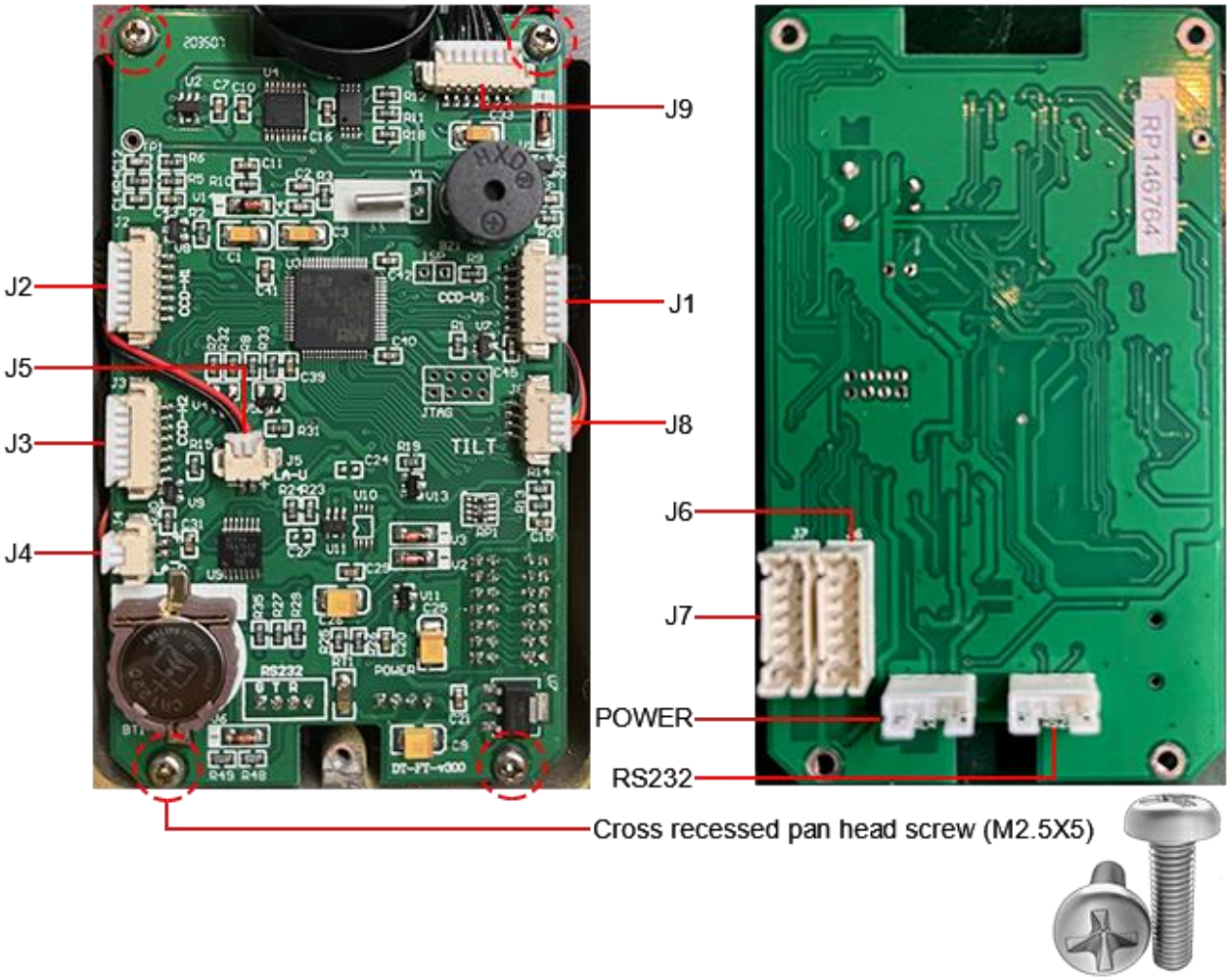
2. Remove the left cover.

After disassembling the left cover, the structure is as follows:



3.2 Disassemble the Mainboard

The structure of the mainboard is as follows:



Connector	Definition	Connector	Definition
J1	Vertical lower end CCD connector	J2	Horizontal near-end CCD connector
J3	Horizontal far-end CCD connector	J4	Laser plummet (lower) connector
J5	Laser plummet (upper) connector	J6	Display connector
J7	Display connector	J8	Compensator connector
J9	Vertical upper end CCD connector	POWER	Power connector
RS232	Reserved		

CAUTION Please do not put the mainboard on the electroconductive surface.

To disassemble the mainboard, do the following:

1. Use tweezers to remove the connectors J1, J2, J3, J4, J5, J8 and J9 on the front from the mainboard.

   It is suggested to make a mark for different connection before removing the connections.

   CAUTION During this process, please be mindful of electrostatic protection.

2. Loosen four cross recessed pan head screws (M2.5X5) that fix the mainboard.
3. Use tweezers to remove the connectors J6, J7, POWER and RS232 on the back from the mainboard, and remove the mainboard.

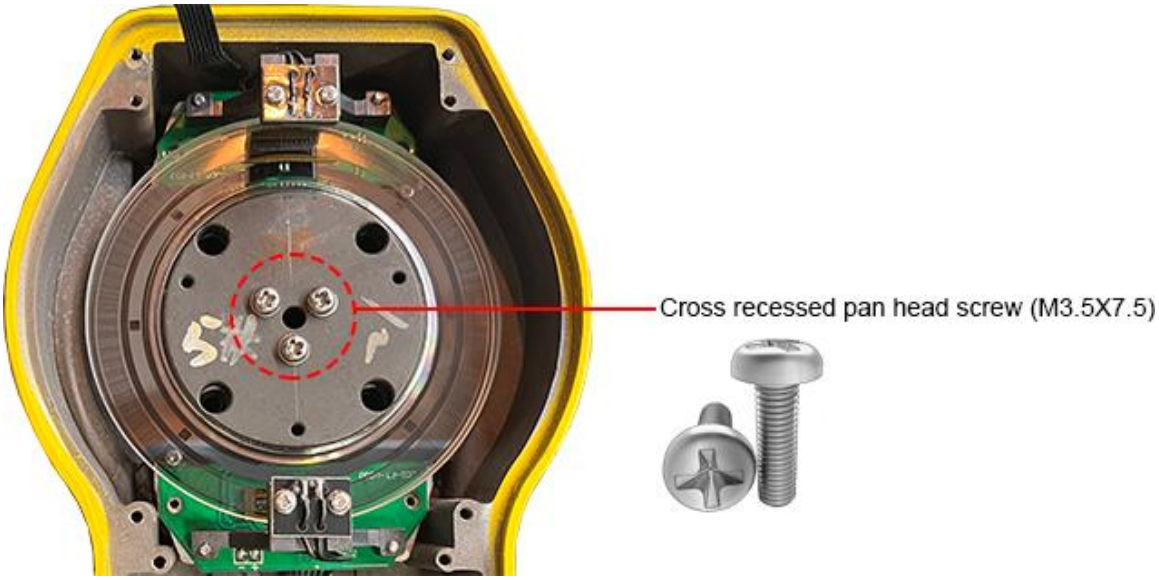
3.3 Disassemble the Vertical Circle

You can clean the vertical circle with alcohol and cotton swabs.

To disassemble the vertical circle, do the following:

1. Loosen two cross recessed pan head screws (M2X16) that fix the cover:

2. Remove the cover:



3. Remove three cross recessed pan head screws (M3.5X7.5) that fix the vertical circle, and remove the vertical circle:

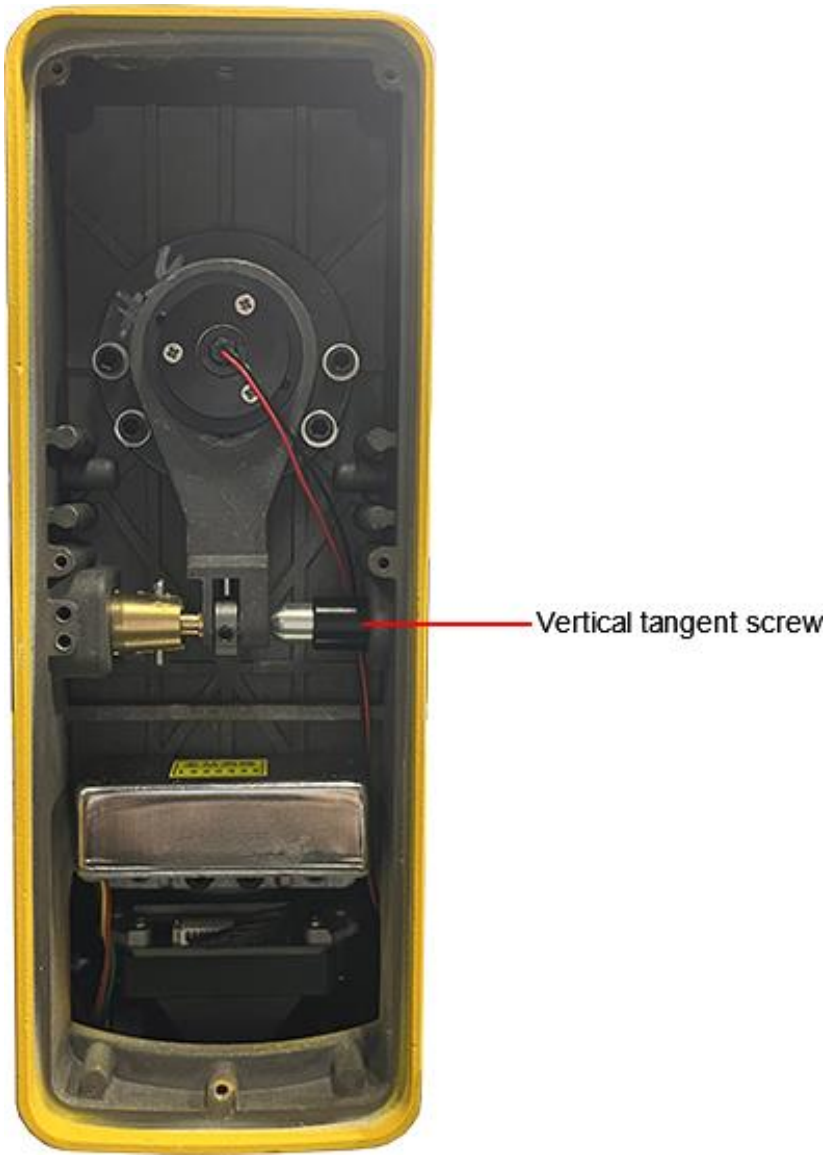
3.4 Disassemble the Right Cover

To disassemble the right cover, do the following:

1. Remove four 90° countersunk flat head screws M2.5X7 that fix the right cover:

2. Remove the right cover.

After disassembling the right cover, the structure is as follows:



3.5 Disassemble the Vertical Tangent Screw

To disassemble the vertical tangent screw, do the following:

1. Unscrew the shorter mandril seat of the vertical tangent screw, and remove the shorter mandril seat.

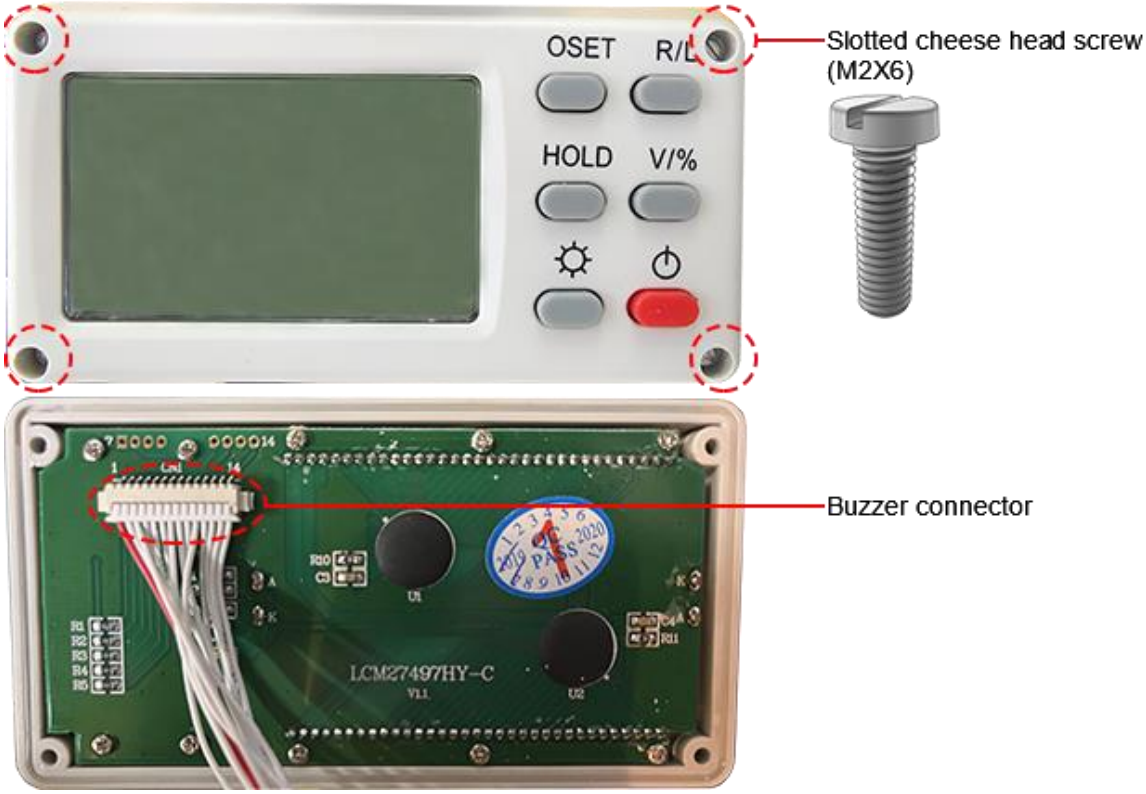
2. Loosen the two hexagon socket set screws (M2X3).

NOTE There is no need to remove them.

3. Pull out the vertical tangent screw:

3.6 Disassemble the Display

The structure of the display is as follows:



To disassemble the display, do the following:

1. Remove 4 slotted cheese head screws (M2X6) that fix the display.

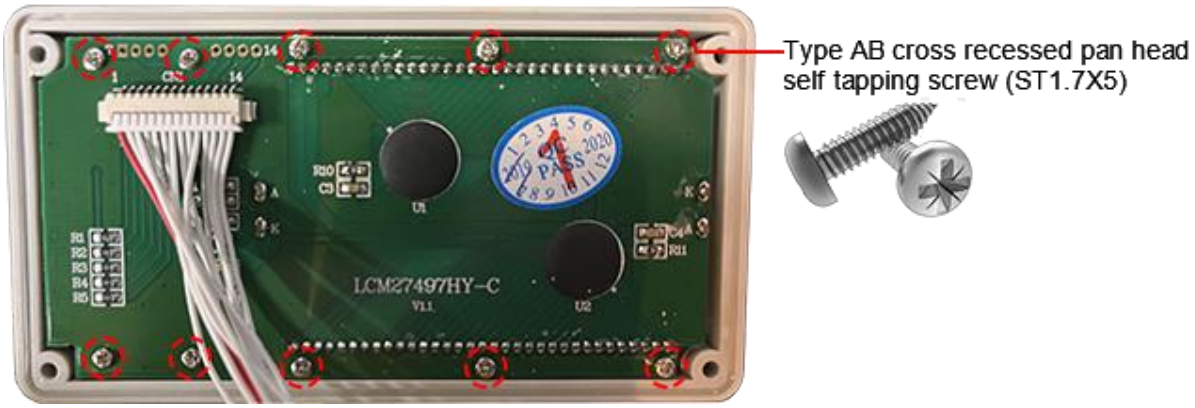
   CAUTION Be careful. The buzzer exists on back of the display.

2. Pull out the display cable, and remove the display.
3. Repeat step **1** ~ **2** to disassemble the other display.

3.7 Disassemble the LCD Module

To disassemble the LCD module, do the following:

1. Remove 10 type AB cross recessed pan head self tapping screws (ST1.7X5):

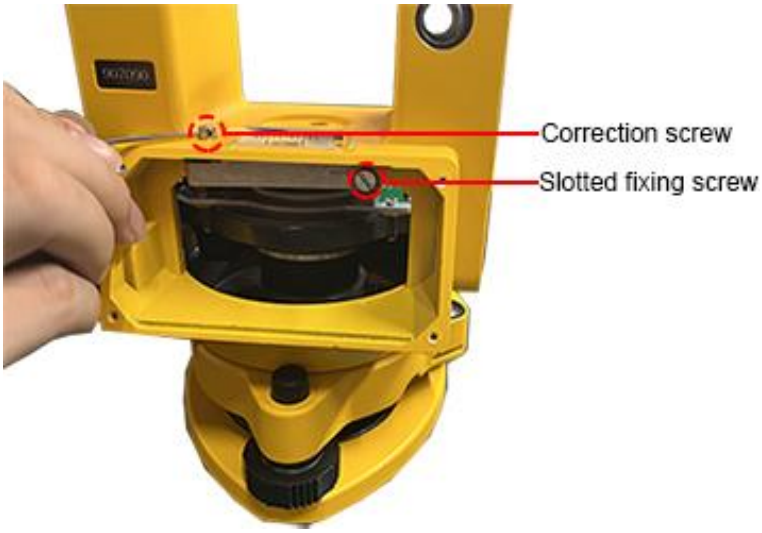


2. Remove the LCD module:

3.8 Disassemble the Plate Level

To disassemble the plate level, do the following:

1. Loosen the correction screw of the bubble with the adjusting pin, and remove it.



2. Unscrew the slotted fixing screw of plate level with slotted screwdriver, take down the slotted fixing screw.
3. Take down the plate level:

3.9 Disassemble the Horizontal Tangent Screw

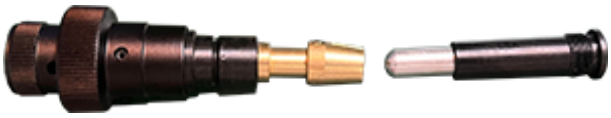
To disassemble the horizontal tangent screw, do the following:

1. Unscrew the shorter mandril seat of the horizontal tangent screw, and remove the shorter mandril seat:

2. Loosen the two hexagon socket set screws (M2X3):

NOTE There is no need to remove it.

3. Pull out the horizontal tangent screw.



4 Assembling

DANGER When assembling the instrument, please carefully protect each part. It is forbidden to assemble parts not mentioned here.

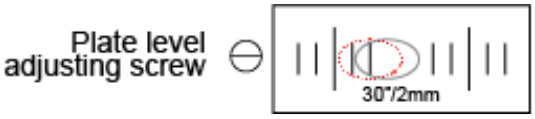
The process of instrument assembling is totally contrary to the instrument disassembling. Please see Disassembling for details.

5 Check and Adjustment

5.1 Check and Adjust the Plate Level

To check and adjust the plate level, do the following:

1. Level the plate level for precise leveling of the instrument.
2. Rotate the instrument 180° (200 gon), and observe if the bubble moves from the center:
   - If it does, proceed to step **3** - **5**.
   - If not, no adjustment is required
3. Adjust the foot screw that is parallel to the plate level, and move the bubble half of the shift to the center of the plate level:

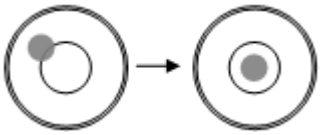


4. To move the bubble the remaining half distance towards the center of the plate level, adjust the adjusting screw of the plate level with the adjustment pin.
5. Repeat step **3** - **5** until the bubble can remain at the center of the plate level when the plate level rotates to any position.
6. If there is still a problem, do the following:
   a. Disassemble the Display
   b. Disassemble the Plate Level
   c. Replace the plate level.

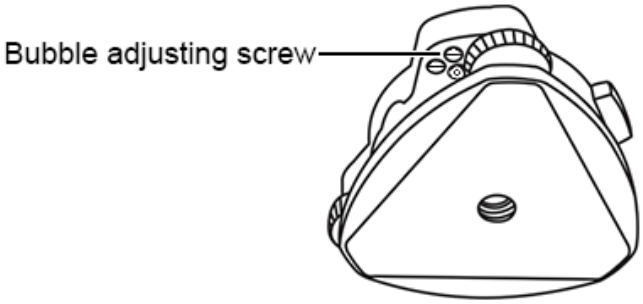
5.2 Check and Adjust the Circular Level

To check and adjust the circular level, do the following:

1. Level the plate level for precise leveling of the instrument.
2. Observe if the bubble of the circular level is within the circle:



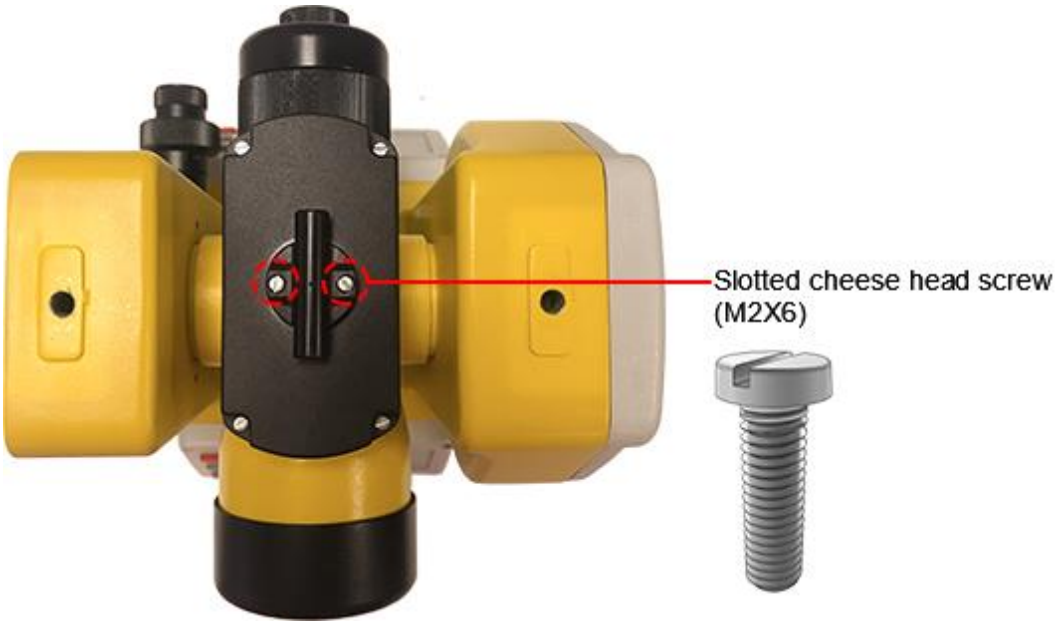
   - If it is, no adjustment is required.
   - If not, proceed to step **3**.
3. Adjust the two bubble adjusting screws with the adjustment pin:



5.3 Check and Adjust the Optical Sight

To check and adjust the optical sight, do the following:

1. Fix the instrument on the calibration stand, and label a cross mark afar.
2. Aim the telescope at this mark, and check if the optical sight collimates this mark:
   - If it does, no adjustment is required.
   - If not, proceed to step **3**.
3. Demount the handle.
4. Loosen the slotted cheese head screws (M2X6) that fix the optical sight:



5. Fix the tightening screws, and make sure the optical sight collimates the mark.

5.4 Check and Adjust the Laser Plummet

To check and adjust the laser plummet, do the following:

1. Fix the instrument on the calibration stand.
2. To turn on the laser plummet, press ⏻ 1 second after powering on the instrument.
3. Turn foot screws, and make sure the bubble is in the center of the plate level and the laser spot coincide with the cross target:

4. Rotate the instrument, and observe if the bubble and the laser spot still coincides with the cross target:
   - If it does, no adjustment is required.
   - If not, proceed to step **5**.

5. Making the laser spot move half distance towards the center of the cross target by loosening or tightening the four hexagon socket set screws:

> NOTE When loosening one screw, please tighten the opposite screw.

6. Repeat step **5** until the laser spot entirely coincides with the cross target when rotating the instrument in any direction.

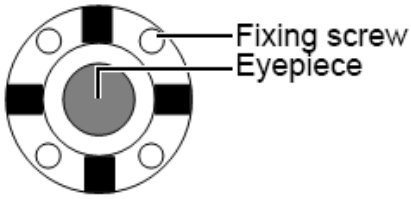
5.5 Check and Adjust the Vertical Line of the Reticle

If the vertical line of the telescope reticle is not perpendicular to the horizontal axis of the telescope, adjustment is required (because one point on the vertical line may be used to collimate the target for horizontal angle measurement or for vertical staking).

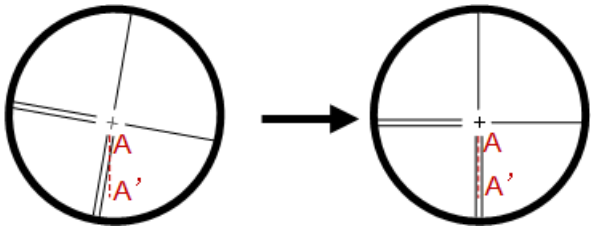
To check and adjust the vertical line of the reticle, do the following:

1. Set the instrument on the tripod or the calibration stand, and precisely level it.
2. Set a point A at 50 m away from the instrument.
3. Collimate the telescope of the instrument to point A, turn the vertical tangent screw, and observe if point A moves along the vertical line of the reticle:
   - If it does, no adjustment is required.
   - If not, proceed to step **4** - **8**.

4. Turn the eyepiece cover of the reticle counterclockwise, and remove the cover to expose the cross recessed pan head screws-fixing screws (M2.5X8) that fix the eyepiece:



5. Use a cross screwdriver to slightly loosen the four M2.5X8 screws that fix the eyepiece.
6. Turn the eyepiece end until the vertical line of the reticle overlaps with point A:



7. Tighten the four M2.5X8 screws that fix the eyepiece.
8. Repeat calibration until point A always moves along the vertical line of the reticle.

After doing correction for the vertical line of the telescope reticle, check the collimation error and index error of the instrument.

5.6 Check and Adjust the Line-of-Sight Error or Collimation Error

The line-of-sight error or collimation error (C) is the deviation from the perpendicular between the tilting axis and the line of sight, and it affects the horizontal angle readings and increases with steep sightings. When the error is greater than 8", adjustment of the collimation error is required.

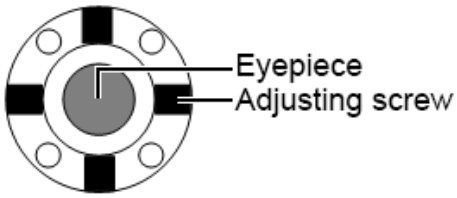
These errors should be determined before the instrument is used for the first time, before precision surveys, after long periods of transport, before and after long periods of work, and if the temperature changes by more than 10°C (18°F).

To adjust the line-of-sight or collimation error, do the following:

1. Set the instrument on the tripod or the calibration stand, and precisely level it.
2. Enter angle measurement after powering on the instrument.
3. Aim at the first target A, and press **0SET** twice to set the horizontal reading of target A as 0°00'00".
4. Aim at the second target B. The horizontal angle to target B shows (HA1).
5. Rotate the instrument 180°.
6. Repeat step **3** - **4**. The horizontal angle to target B shows again (HA2).
7. Calculate the collimation error:

   C = (HA1 - HA2 ± 180°) / 2
8. Judge if the error is within the allowable range:
   - If it is less than or equal to 8", no adjustment is required.
   - If it is greater than 8", proceed to step **9** - **11**.

9. Rotate the instrument in the right position, and make the reading is HA2' = HA2 + C.
10. Remove the eyepiece cover to adjust the two horizontal adjusting screws until the reticle coincides with the reticle of collimator or the target:



11. Repeat the whole process of checking and adjusting the collimation error until the error is less than or equal to 8''.

5.7 Check and Adjust the Vertical Index Error

The deviation between vertical circle zero position and horizontal direction is vertical index. It is necessary to concern this error when measuring vertical angle.

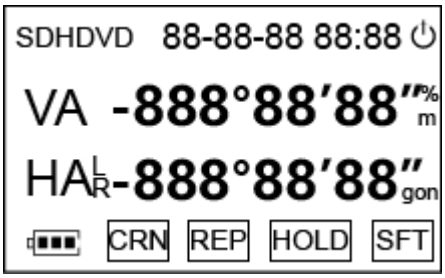
Because of the close relationship between vertical index and compensator zero position, it is necessary to check and adjust compensator zero position when adjusting the vertical circle, to keep the value stable when reading.

To check and adjust the vertical index error, do the following:

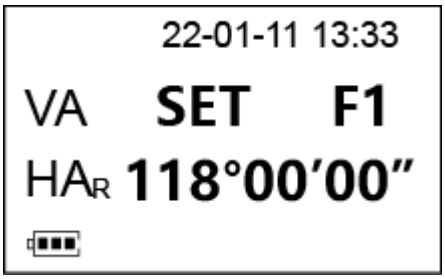
1. Set the instrument on the tripod or the calibration stand, and precisely level it.
2. Enter angle measurement after powering on the instrument.
3. Aim at target A. The vertical angle shows (VA1).
4. Rotate the instrument 180°.
5. Aim at target A again. The vertical angle shows (VA2).
6. Calculate the vertical index error:

   C = (VA1 - VA2 ± 360°) / 2
7. Judge if the error is within the allowable range:
   - If it is less than or equal to 10'', no adjustment is required.
   - If it is greater than 10'', proceed to step **8** - **12**.

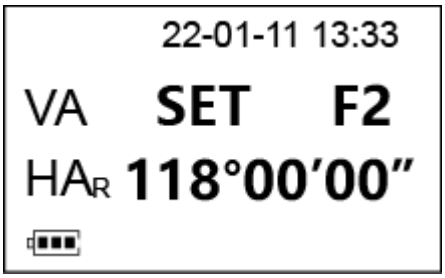
8. Press ⏻ to power on the instrument, and long press **R/L** when the following display shows:



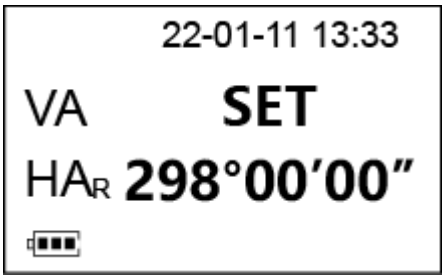
The following result shows:



9. Aim at the reticle of collimator or the obvious target at a distance, and press **0SET**:



10. Rotate the instrument 180°.
11. Aim at the reticle of collimator or the obvious target at a distance, and press **0SET** twice.



12. Repeat the whole process of checking and adjusting the vertical index error until the error is less than or equal to 10".

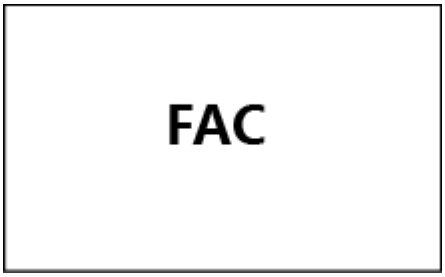
5.8 Check and Adjust the Linearity of the Compensator

To check and adjust the linearity of the compensator, do the following:

1. Fix the instrument on the calibration stand.
2. Make the light axis collimator upright with the connecting line of two foot screws of the tribrach.

   The projection of light axis should be through the third foot screw.

3. To precisely level the instrument up, make the plate level parallel to the connecting line of two foot screws, and turn the third foot screw.
4. To power on the instrument, press ⏻ for 3 seconds, and make sure the compensator is turned on (Character CRN shows).
5. Aim the telescope at the reticle center on the face left, and write down the vertical angle VI.
6. Adjust the third foot screw, make the instrument tilt 3' (6 lattices set in the reticle) upwards, turn the vertical tangent screw, collimate the target again, and write down the vertical angle VI1.
7. Adjust the third foot screw, make the instrument tilt 3' (12 lattices set in the reticle) downwards, turn the vertical tangent screw, collimate the target again, and write down the vertical angle VI2.
8. Calculate the value of |VI1-VI| and |VI2-VI|, and check if the results are less than 5':
   - If they are, no adjustment is required.
   - If not, proceed to step **9**.
9. To enter the factory setting, power off the instrument, press ⏻, **V/%** and **R/L** at the same time, release ⏻, and release **V/%** and **R/L** at the same time when character **FAC** shows. The character **SETP1** flashes on the second line on the display.



10. Adjust the third foot screw to aim the target, write down the vertical angle VI1, and press **OSET**. The character **SETP2** flashes on the second line on the display.
11. Adjust the vertical tangent screw, and make the vertical angle plus 3'.
12. Adjust the third foot screw to aim the target, write down the vertical angle VI2, and press **0SET**. The character **SETP3** flashes on the second line on the display.
13. Adjust the vertical tangent screw, and make the vertical angle minus 6'.
14. Adjust the third foot screw to aim the target, write down the vertical angle VI3, and press **0SET**.
15. Mare the maximum among VI1, VI2 and VI3 as VImax and the minimum as VImin.
16. Calculate the value of |VImax-VImin|, and check if the result is less than 6''.
    - If it is, adjustment finishes.
    - If not, repeat step **9** - **16**.

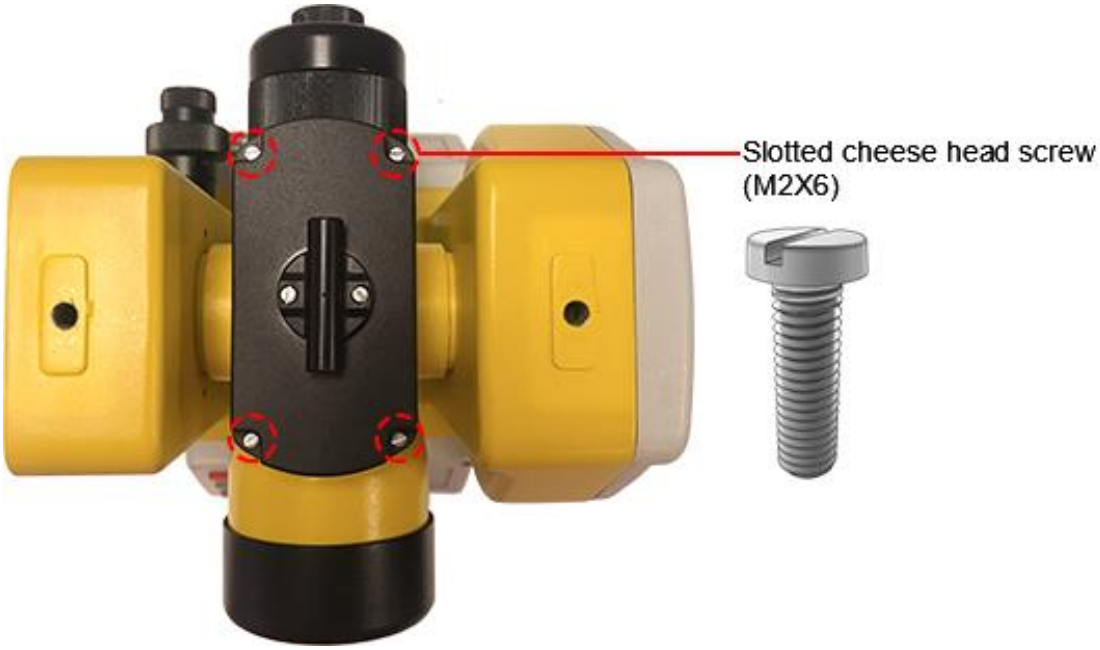
5.9 Check and Adjust the Coinciding of the Laser Spot and Target Center

The laser spot coincides with the target center when the reticle center of the telescope coincides with the target center. If not, adjustment is required.

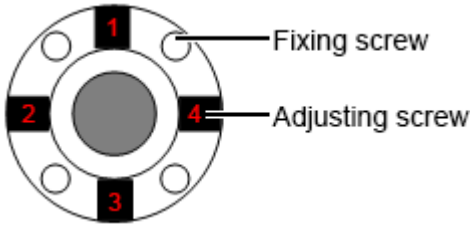
To check and adjust the coinciding of the laser spot and target center, do the following:

1. Make the reticle center of the telescope coincides with the target center.
2. Observe if the laser spot coincides with the target center:

   - If it does, no adjustment is required.
   - If it not, proceed to step **3**.
3. Demount the handle, unscrew four slotted cheese head screws (M2X6) that fix the cover of the laser device, and remove the cover of the laser device:



4. To make the laser spot coincide with the target center, adjust the four adjusting screws:



6 Troubleshooting

This part only lists the common problems you may encounter. If you encounter other problems, please contact us.

6.1 Failed to Power on the Instrument

Bad battery or out of battery

Replace a new and fully charged battery.

The electrode is damaged

- Polish the electrode head to remove the oxide layer.
- Replace the electrode.

The cable for the buzzer connector is loose

Connect the cable again:

The cable for the buzzer connector is damaged

1. Disassemble the Display
2. Replace the cable.

6.2 The Instrument Automatically Powered Off

The battery is low

Fully charge the battery.

Short circuit of the mainboard

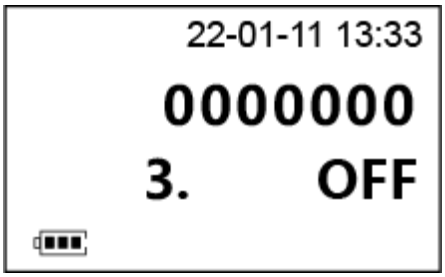
The mainboard is damaged or burnt.

1. Disassemble the Mainboard
2. Replace the mainboard.

Incorrect setting

The automatic power-off function is activated, which is used to prevent unnecessary power consumption. With it activated, the instrument will automatically power off after 30 minutes if no action is carried out.

1. Press ☼ → **R/L** to enter configuration mode:
2. Press **0SET** to turn to the following page:



3. To turn off automatic power-off function, press **R/L** to change the value to **OFF**.
4. Press ☼ for confirmation.

6.3 Unstable Horizontal Angle

Short circuit of the mainboard

The mainboard is damaged or burnt.

1. Disassemble the Mainboard
2. Replace the mainboard.

Incorrect setting

Restore to the factory settings.

Others

Contact us.

6.4 Unstable Vertical Angle

The vertical circle is dirty

The vertical circle is dirty. It is required to disassemble it and clean it.

1. Disassemble the Vertical Circle
2. Clean the vertical circle with alcohol and cotton swabs.

The telescope turns too fast

It belong to a protective error.

Turn the telescope slowly.

Short circuit of the mainboard

The mainboard is damaged or burnt.

1. Disassemble the Mainboard
2. Replace the mainboard.

Incorrect setting

Restore to the factory settings.

Others

Contact us.

6.5 Character TILT Shows

The working range of the compensator is at ±3' (±0.05.56 gon). If the tilt angle exceeds the work range, the vertical angle will show **TILT** on the display.

The plate level is no levelled

Level the plate level.

Others

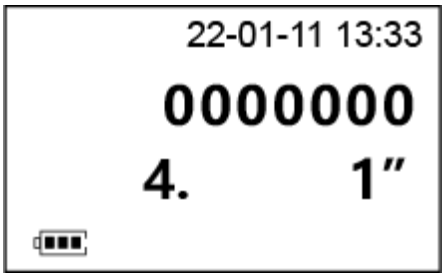
Contact us.

6.6 Serious Error in the Horizontal Angle

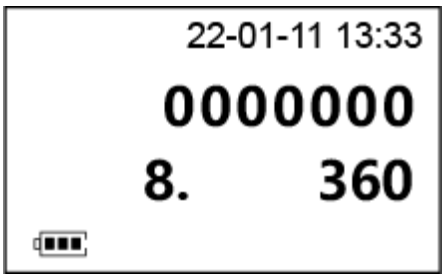
Incorrect settings

The setting of the minimum reading angle and angle unit are incorrect.

1. Press ☼ → **R/L** to enter configuration mode:
2. Press **0SET** to turn to the following page:



3. Press **R/L** to select **1"**.
4. Press **0SET** to turn to the following page:



5. To set degree sexagesimal as the angle unit, press **R/L** to change the value to **360**. Possible angle values: 0° to 359°59'59"
6. Press ☼ for confirmation.

Short circuit of the mainboard

The mainboard is damaged or burnt.

1. Disassemble the Mainboard
2. Replace the mainboard.

Incorrect setting

Restore to the factory settings.

Others

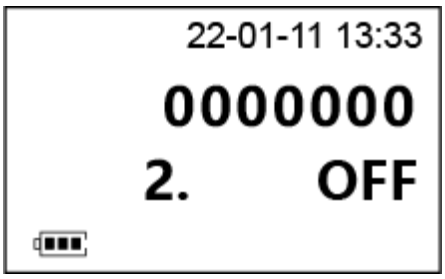
Contact us.

6.7 Serious Error in the Vertical Angle

Incorrect setting

The setting of zenith is incorrect.

1. Press ☼ → **R/L** to enter configuration mode.
2. Press **0SET** to turn to the following page:



3. To define the zenith as 90°00'00", press **R/L** to change the value to **ON**.
4. Press ☼ for confirmation.

The vertical circle is dirty

The vertical circle is dirty. It is required to disassemble it and clean it.

1. Disassemble the Vertical Circle
2. Clean the vertical circle with alcohol and cotton swabs.

Short circuit of the mainboard

The mainboard is damaged or burnt.

1. Disassemble the Mainboard
2. Replace the mainboard.

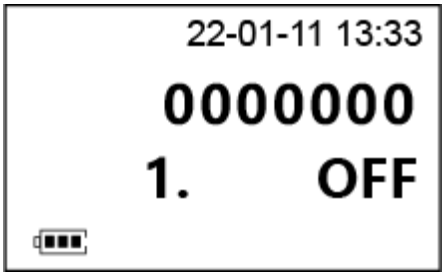
Incorrect setting

Restore to the factory settings.

The compensator is on

The compensator normally remains switched on.

1. Press ☼ → **R/L** to enter configuration mode:
2. Press **0SET** to turn to the following page:



3. To switch off the compensator, press **R/L** to change the value to **OFF**.
4. Press ☼ for confirmation.

Others

Contact us.

6.8 The Horizontal Tangent Screw is Broken

The horizontal tangent screw needs to be replaced.

See Disassemble the Horizontal Tangent Screw for details.

6.9 The Vertical Tangent Screw is Broken

The vertical tangent screw needs to be replaced.

See Disassemble the Vertical Tangent Screw for details.

6.10 Display Error

The LCD is yellow, the screen is blurred, or there is no display.

The cable for the buzzer connector is loose

Connect the cable again:

The LCD module is damaged

1. Disassemble the Display
2. Disassemble the LCD Module
3. Replace the LCD module.

e-survey

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